

# **FASTENER AND WASHER ASSEMBLY AND METHOD OF FORMING SAME**

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## **RELATED APPLICATIONS**

[00001] This application claims priority to U.S. Provisional Application Serial No. 60/451,558 filed March 3, 2003.

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## **FIELD OF THE INVENTION**

[00002] This invention relates to a fastener and washer assembly and method of forming same, wherein the fastener may rotate relative to the washer, but the washer is retained on the fastener.

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## **BACKGROUND OF THE INVENTION**

[00003] There are many applications which require a washer located between the head or body of the fastener and a substrate to which the fastener is threadably attached, particularly including mass production applications such as automotive applications, where a torque wrench is used to thread the fastener. At present, a washer may be manually placed between the substrate and the fastener head or body in such applications. However, manual placement of a washer requires a separate step which may also be difficult in certain applications. Alternatively, there are nut and washer assemblies available on the market, wherein the washer is rotatably supported on a specially designed nut in a groove in an annular body portion of the nut. A fastener and washer assembly including a washer and bolt assembly utilizing a conventional nut or bolt would, however, be more desirable, particularly from a cost standpoint.

[00004] Another problem associated with a fastener and washer assembly, wherein the fastener is rotatably supported on the washer, is that the fastener and washer may have different strength or hardness requirements. For example, the fastener may require heat treatment or a special protective coating and  
5 the washer may preferably be formed from a softer metal or without a protective coating. Thus, it would be desirable to form the washer and fastener assembly after heat treatment or application of a protective coating to the fastener.

[00005] The fastener and washer assembly of this invention achieves these advantages or objects including the use of a conventional nut or bolt and may be  
10 assembled after heat treatment or coating of the fastener.

### **SUMMARY OF THE INVENTION**

[00006] The fastener and washer assembly of this invention may include a conventional nut or bolt particularly, but not exclusively, including a  
15 conventional commercially available flange nut or flange bolt having a frustoconical flange or skirt portion, thereby significantly reducing the cost. Further, the fastener and washer assembly of this invention may be assembled after heat treatment or application of a protective coating on the fastener.

[00007] The fastener and washer assembly of this invention includes a  
20 conventional fastener, such as a conventional flange bolt or flange nut, and a washer rotatably supported on the fastener. The washer includes a central flat or planar bearing portion having an opening therethrough and opposed upwardly angled end portions or ears on opposed sides of the bearing portion each having an elongated opening extending generally perpendicular to the axis of the opening through the  
25 central planar portion which receive the flange or skirt portion of the nut or bolt. The

ears are preferably angled relative to the planar bearing portion at an angle of less than 90 degrees, preferably between 30 and 85 degrees, and more preferably between 40 and 80 degrees. The ears may also be bowed outwardly to permit greater movement of the washer relative to the fastener for alignment purposes.

5           **[00008]**           The method of assembling the fastener and washer assembly of this invention includes forming a flat generally rectangular washer having a central opening and elongated generally parallel openings on opposed sides of the central opening. The ear portions are then formed by bending the plate adjacent the juncture of the elongated openings at an angle of less than 90 degrees or preferably between 30  
10   and 85 degrees, such that the openings are aligned with the flat central bearing portion of the washer.

**[00009]**           The fastener, such as a conventional flange nut or flange bolt, is then assembled on the washer by driving the flange or skirt portion of the nut or bolt against at least one of the upwardly angled ear portions and snapped in place. Thus,  
15   the method of assembling a fastener and washer assembly of this invention may also include pretreatment of the fastener, such as heat treatment or application of a protective coating. In the one preferred embodiment of the washer, the elongated slots on opposed sides of the central opening include an arcuate or semi-circular inner wall providing additional bearing support for the fastener and providing semi-circular  
20   surfaces which support a conventional flange nut or flange bolt, but permits lateral movement toward and away from the end portions.

**[00010]**           In a preferred embodiment of the fastener and washer assembly, the fastener includes a polygonal body portion and a frustoconical radial flange portion integral and coaxially aligned with the polygonal body portion. Where  
25   the fastener is a female fastener or nut, the female fastener includes a bore through the

polygonal body portion and the frustoconical flange portion which may internally threaded as required. Where the fastener is a male fastener, such as a stud, the male fastener may include a shank portion integral with the radial flange portion which may be externally threaded as required. As described above, the washer assembled on

5 the fastener includes a planar bearing portion having a central opening, preferably a cylindrical opening, and generally parallel openings or slots on opposed sides of the central opening equally spaced from the central opening and inclined end portions or ears on opposed ends of the planar bearing portion, wherein the ears are bent upwardly from the planar bearing portion through the slot to receive the frustoconical

10 radial flange portion of the fastener through the slots during assembly. In a preferred embodiment, the inner wall of the elongated slots adjacent the central opening is semi-circular providing full bearing support for the circular radial flange portion of the fastener. Thus, the washer is rotatably supported on the fastener and the fastener can freely rotate relative to the washer during threaded attachment of the fastener. As

15 will be understood, a female fastener will normally be threaded onto a male fastener typically located on the other side of a substrate, such as a bracket or other part. Similarly, a male fastener, such as a bolt, will typically be threaded into a female fastener, such as a nut, again typically on the opposite side of the substrate, such that the washer will bear against the substrate during threading of the fastener.

20           **[00011]**           As will be understood by those skilled in this art, various modifications may be made to the disclosed embodiments of the washer, fastener and washer and fastener assembly within the purview of the appended claims. The embodiments of the fastener and washer assembly and method of forming a fastener and washer assembly disclosed herein are for illustrative purposes only.

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**BRIEF DESCRIPTION OF THE DRAWINGS**

[00012] Figure 1A is a top view of one embodiment of a washer blank prior to forming the ears;

[00013] Figure 1B is a top view of an alternative embodiment of a  
5 washer blank;

[00014] Figure 2A is a top view of the washer blank shown in Figure 1A following forming of the ears from the blank;

[00015] Figure 2B is a side view of the washer after forming the ears from the blank shown in Figure 1B;

10 [00016] Figure 3 is a perspective view of the washer shown in Figure 2A;

[00017] Figure 4 is an end view of one embodiment of a nut and washer assembly of this invention;

[00018] Figure 5 is a top view of the nut and washer assembly shown in  
15 Figure 4;

[00019] Figure 6 is a side view of the nut and washer assembly shown in Figures 4 and 5;

[00020] Figure 7 is a perspective view of the nut and washer assembly shown in Figures 4 to 6;

20 [00021] Figure 8 is a side view of the nut and washer assembly shown in Figures 4 to 7 during assembly of the nut and washer assembly;

[00022] Figure 9 is a side view of one embodiment of a bolt and washer assembly of this invention;

[00023] Figure 10 is a top view of the bolt and washer assembly shown  
25 in Figure 9;

[00024] Figure 11 is a side view of Figure 10;

[00025] Figure 12 is a perspective view of the bolt and washer assembly shown in Figures 9 to 11; and

[00026] Figure 13 is a side view of the bolt and washer assembly shown  
5 in Figure 11 during assembly of the washer on the bolt illustrating the method of assembly.

### **DESCRIPTION OF THE PREFERRED EMBODIMENTS**

[00027] Figure 1A illustrates one preferred embodiment of a flat  
10 rectangular washer blank 20B having linear or planar side faces 22 and linear or planar end faces 24. The rectangular washer blank 20B further includes a central circular opening 26 spaced generally equally between the side faces 22 and the end faces 24. The washer blank 20B also includes elongated generally parallel openings or slots 28 on opposed sides of the central opening 26 adjacent the side faces 24  
15 equally spaced from the central opening 26 and extending perpendicular to the axis of the central opening 26. In this embodiment, the elongated openings 28 each include a curvilinear inner side wall 30, which are generally semi-circular, providing a flat generally circular bearing face 34 as described further below. The elongated openings 28 in this embodiment may also include linear outer side walls 32. The embodiment  
20 of the washer blank 120B in Figure 1B is also generally rectangular and includes linear side faces 122, but the end faces 124 are curvilinear or generally semi-circular each having an axis coincident with the circular center opening 126, such that the elongated openings 128 on opposed sides of the central opening 126 are also generally semi-circular having a curvilinear or generally circular inner side wall 132  
25 and a generally semi-circular outer side wall 132. That is, the nut blank 120B in

Figure 1B is similar to the nut blank 20B shown in Figure 1A except that the end faces 124 are generally semi-circular and the elongated openings 128 are also semi-circular.

[00028] Figures 2A and 3 illustrate the washer 20 after forming the ears  
5 on washer blank 20B shown in Figure 1A. As shown in Figure 2A, the end faces 24 have been deformed upwardly at an angle relative to the flat bearing face 34 of less than 90 degrees and preferably between 30 and 85 degrees, or more preferably between 40 and 80 degrees. As best shown in Figure 3, the end portions 36 are bent  
10 upwardly about a linear axis 38 which is generally coincident with the ends of the semi-circular inner side walls 30, such that the generally circular bearing face 34 remains flat. The washer 120 is similarly formed, such that the end portions 136 are planar and deformed upwardly at an angle of less than 90 degrees relative to the bearing face 134, as described above in regard to Figure 2A, except that the end faces 124 are generally semi-circular as described above in regard to Figure 1B.

15 [00029] Figures 4 to 7 illustrate a nut and washer assembly of this invention, wherein the washer 20 is assembled on a conventional flange nut 40. As will be understood by those skilled in this art, a conventional flange nut 40 includes a body portion 42 having a polygonal outer surface 44, typically hexagonal, as shown, or octagonal, a threaded opening 46 and a radial flange or skirt portion 48 having a  
20 frustoconical outer surface 50 and a circular or cylindrical rim portion 52. Although the fastener and washer assembly of this invention is not limited to a conventional flange nut or flange bolt (shown in Figures 9 to 13), one important object of this invention is to utilize a conventional nut or bolt of the type commonly used in mass production applications, such as the automotive industry, to reduce costs and to meet  
25 the existing specifications of such manufacturers.

[00030] As shown in Figure 8, the washer 20 is assembled on the flange nut 40 by receiving the radial flange or skirt portion 48 into one of the elongated openings 28 and the radial flange portion is then snapped into the opposed elongated opening 28 by a force shown by arrow P which may be applied by hand or preferably by a press. As set forth above, the female fastener and washer assembly shown in Figures 4 to 7 will typically be threaded on a male fastener which extends through an opening in a substrate, such as a bracket, wherein the washer 20 is supported on the substrate and the nut is threaded on a threaded portion of a male fastener (not shown). Similarly, the bolt and washer assembly shown in Figures 9 to 12 described below is typically received through an opening in a substrate and a nut or other female fastener is threaded onto the end of the bolt, wherein the washer 20 is received against the substrate. Upon assembly, the central opening 26 of the washer 20 may be coaxially aligned with the threaded opening 46 of the washer 20, as shown in Figure 6, and the flange nut 40 is free to rotate relative to the washer. The radial flange or skirt portion 48 of the nut 40 is received on the flat semi-circular bearing surface 34 of the washer 20, shown in Figures 2A and 3, providing an enlarged bearing area which fully supports the radial skirt or flange portion 48 of the nut 40. The flange nut 40 is also free to move laterally toward and away from the upwardly angled end or ear portions 36 because the slots formed by the elongated openings 28 have a width greater than the minor diameter of the frustoconical outer surface 50

[00031] Figures 9 to 12 illustrate a bolt and washer assembly of this invention, wherein the washer 20 is assembled on a conventional flange bolt 54. As will also be understood by those skilled in this art, a conventional flange bolt 54 includes an elongated shank portion 56, which is typically externally threaded as shown at 58, and a head portion 60, which is substantially identical to the flange nut



40 described above. That is, the head portion 60 includes a polygonal outer surface 62 and a radial flange or skirt portion 64. The skirt portion 64 typically includes a frustoconical surface 66 and a circular or cylindrical rim portion 68. As described above with regard to Figure 8, the washer 20 is assembled on the flange bolt 54 by  
5 driving the skirt portion 66 as shown by arrow P, which snaps the skirt portion 66 into the elongated openings 28 of the washer. That is, the force P causes the angled end portions 36 to spread or deflect radially outwardly, receiving the flange portion 66 into the elongated openings 28. In this embodiment, the shank portion 56 is first received through the central opening 26 prior to snapping the washer 20 on the flange  
10 bolt 54. The semi-circular flat bearing surface 34 shown in Figures 2A and 3 similarly supports the radial flange or skirt portions 64 as described above.

[00032] As will be understood by those skilled in this art, a conventional or typical flange nut is formed of carbon steel, such as ASTM A563M, which is typically heat treated. A conventional flange bolt is also generally formed of  
15 steel, such as ASTM F568M or SAE J1199 and heat treated to Rockwell 42 to 48. The flange nut or flange bolt may then be coated with a protective coating, such as a zinc coating or a black oxide. A flange nut or flange bolt is then threaded onto a bolt in the nut and washer assembly of this invention or into a threaded opening in the bolt and washer assembly of this invention. In mass production applications, the fastener  
20 is typically threaded using a conventional torque wrench set at about 1370 in./lbs. With the method of forming a fastener and washer assembly of this invention, the flange nut or flange bolt may be heat treated and coated to the manufacturer's specifications and then assembled on the washer of this invention by simply snapping the washer in place as described above. However, the fastener will freely rotate on  
25 the washer following assembly. As will now be understood, the inclination of the end

portions 36 of the washer is preferably less than 90 degrees to permit the washer to be snapped on the fastener. However, the angle of inclination should be greater than 40 degrees and less than 90 degrees to assure that the washer remains on the fastener and the washer may be snapped in place on the fastener.

5           **[00033]**       Having described preferred embodiments of the fastener and washer assembly and a method of assembly, it will be understood by those skilled in this art that various modifications may be made within the purview of the appended claims. For example, end portions 36 may be bowed outwardly as shown in phantom at 36A in Figure 2A to provide greater clearance. Further, the opening 26 may be  
10    elongated toward the end faces 24 to accommodate misalignment. The washer may also be welded to the substrate by providing conventional weldable dimples (not shown) on the flat bearing portion opposite the fastener preferably adjacent the end faces. The washer 20 is preferably formed of steel, such as SAE 1050 or 1065, but is preferably not heat treated.